

REMARKS

Claims 1-14 are active in the present application. Reconsideration is respectfully requested.

The present invention relates to a method of heterogeneously catalyzing the partial gas phase oxidation of acrolein to acrylic acid.

Claim Amendments

Claim 1 has been amended to correct two minor typographical errors in the claim. Neither of the amendments raises a new issue after final Action, nor do they introduce new matter into the record. Entry of the amendments is respectfully requested.

Invention

The present invention is directed to a process for partially oxidizing acrolein to acrylic acid in the gas phase under heterogeneous catalysis by passing a starting gas mixture which comprises acrolein, molecular oxygen and at least one inert gas containing at least 20 % by volume of molecular nitrogen and contains molecular oxygen and the acrolein in a molar $O_2:C_3H_4O$ ratio of ≥ 0.5 through one reaction stage over a fixed catalyst bed which is arranged in two spatially successive reaction zones A,B, the temperature of reaction zone A being a temperature in the range from 230 to 320° C and the temperature of reaction zone B likewise being a temperature in the range from 230 to 320° C, whose active composition in each reaction zone is at least one multimetal oxide comprising the elements Mo and V, in such a way that reaction zone A extends to an acrolein conversion of ranging from 45 to 85 mol % and, on single pass of the starting gas mixture through the fixed catalyst bed, the acrolein conversion is ≥ 90 mol % and the selectivity to acrylic acid, based on acrolein converted, is ≥ 90 mol %, the

chronological sequence in which the starting gas mixture flows through the reaction zones corresponding to the alphabetic sequence of the reaction zones, wherein

a) the hourly space velocity of the acrolein contained in the starting gas mixture on over the fixed catalyst bed is ≤ 145 l (STP) of acrolein/l of fixed catalyst bed·h and ≥ 70 l (STP) of acrolein/l of fixed catalyst bed·h,

b) the volume-specific activity of the fixed catalyst bed is either constant or increases at least once in the flow direction of the reaction gas mixture over the fixed catalyst bed, and

c) the difference $T^{\max A} - T^{\max B}$, determined from the highest temperature $T^{\max A}$ which the reaction gas mixture has within the reaction zone A and the highest temperature $T^{\max B}$ which the reaction gas mixture has within reaction zone B, is $\geq 0^\circ$ C. The result of the present process is an acrylic acid product that is produced in a very high selectivity.

Prior Art Rejection, 35 USC 103(a)

Claims 1-8 stand rejected based on 35 USC 103 as obvious over DE 19948523 whose U. S. counterpart is Unverricht et al, U. S. Patent 6,525,217. This ground of rejection is respectfully traversed.

As to the newly cited Unverricht et al '217 patent, it is, in fact, similar to the disclosure of the previously applied Unverricht et al '829 patent in that the '217 patent, in an embodiment, discloses the oxidative conversion of acrolein to acrylic acid in two stages, i.e., in two successive stages or zones identified as C and D (col 13, lines 47 et seq). Like the Unverricht et al '829 patent, the '217 patent discloses a staged heating in zones C and D in which the temperature of the first zone C ranges from 230 to 270° C and the temperature of the second zone D is greater at 250 to 300° C (col 13, lines 57-63). Although there is a partial overlap in temperature of the two ranges, nevertheless, it is a requirement of the staged procedure of the patent that the temperature of the second oxidation stage D must be greater than the

temperature of the first stage C. This is clear from the statement at column 13, lines 61-63 that **the temperature of the reaction zone D at the same time is at least 10° C above the temperature of the reaction zone C.** In fact, the difference in the temperature of each zone must be such that the temperature difference between each zone is up to 15° C, up to 25° C, up to 30° C up to 35° C or up to 40° C (col 14, lines 9-12). On the other hand, as stated at the top of page 5 of the text of the present application, for the oxidative conversion of acrolein to acrylic acid, the temperature difference between the second stage reaction zone B (T_B) and the first reaction zone A (T_A), $T_B - T_A$, is $\leq 0^\circ \text{C}$. This means that the difference in temperature of the two stages is zero or the same, or that the temperature within the second reaction zone B is less than the temperature of the first reaction zone A.

In view of the discussion above, it is believed that the statement on page 7, lines 3-5 of the Office Action is incorrect. That is, while indeed $T^{\text{maxA}} - T^{\text{maxB}}$ in the present invention can be zero, the difference in temperature between reaction zones in the '217 reference must be such that the temperature of reaction zone D must be at least 10° C greater than the temperature of reaction zone C so that the temperature difference between reaction zones C and D can never be zero. Thus, there is no temperature overlap or commonality between the temperature range described in '217 and the $T^{\text{maxA}} - T^{\text{maxB}}$ range of Claim 1 of the present application. In fact, one of skill in the art, considering the scope of the teachings in "217 would not be led to violate the requirement of the reference of conducting the second stage of acrolein oxidation at a higher temperature than the first stage by reversing this procedure and instead conducting the oxidation reaction in the second stage at a temperature lower than the temperature of the first oxidation stage, especially with the expectation of achieving superior yield results. This superiority is demonstrated by the data provided in the table on page 28 of the present specification. Note that the first comparative example in the table is consistent with the '217 patent in that the temperature (T^{maxB}) of 291° C of second stage B is 6° C greater than the

temperature of the first stage ($T^{\max A}$). The selectivity S^{AA} obtained is the lowest of the selectivities shown and is 94.9 %. This value is inferior to the selectivity results of the first two examples of the present invention which are 95.4 and 95.8 %. Clearly, the present invention as claimed is patentably distinguished over the '217 patent and withdrawal of the obviousness ground of rejection is respectfully requested.

Double Patenting Rejection

Claims 1-8 stand rejected based on the judicially created doctrine of obviousness-type double patenting in view of Claims 1-19 of copending application Serial No. 10/803,897.

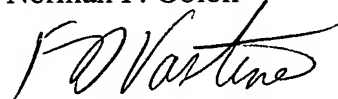
Applicants retain their position as stated on the record previously that the claimed process of the present invention is unobvious over the claimed process of the copending application. As stated previously, the copending '897 application requires that the fixed bed catalyst consist of at least two partially successive fixed catalyst bed zones, and the volume-specific activity within one fixed bed catalyst zone is substantially constant and increases sharply in the flow direction of the reaction gas mixture at the transition from one fixed catalyst bed zone to another fixed catalyst bed zone, and that the transition from temperature zone A to temperature zone B in the fixed catalyst bed does not coincide with a transition from one fixed catalyst bed to another fixed catalyst bed zone. These two process factors do not appear in the present claims, and one of skill in the art would not be motivated to omit important limitations in the claimed process of the copending application to arrive at the present process as claimed with the expectation of producing acrylic acid at the attained high selectivities. Accordingly, withdrawal of the double patenting ground of rejection is respectfully requested.

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It is now believed that the application is in proper condition for allowance. Early notice to this effect is earnestly solicited.

Respectfully submitted,

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